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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/814,670	03/31/2004	Young-Nam Hwang	5649-1288	8320
20792	7590	11/29/2005	EXAMINER	
MYERS BIGEL SIBLEY & SAJOVEC			HO, TU TU V	
PO BOX 37428			ART UNIT	
RALEIGH, NC 27627			PAPER NUMBER	
			2818	

DATE MAILED: 11/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

EJ

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/814,670	HWANG ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Tu-Tu Ho	2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 14 November 2005.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 5-20 is/are allowed.
- 6) ☒ Claim(s) 1-4 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)             | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

### DETAILED ACTION

1. Applicant's Amendment filed 11/14/2005 has been reviewed and placed of record in the file.
2. Applicant's arguments with respect to amended claims 1-4, filed 11/14/2005, have been considered but they are moot in view of new ground(s) of rejection.

#### *Claim Rejections - 35 USC § 102*

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. **Claim 1** is rejected under 35 U.S.C. 102(e) as being anticipated by Johnson et al. U.S. Patent Application Publication 20040113232 (the '232 reference).

The '232 reference discloses in the figures, particularly Fig. 1, and respective portions of the specification a phase-change memory device as claimed.

Referring to **claim 1**, the '232 reference discloses a phase-change memory device comprising:

a phase-change material layer (130, Fig. 1, paragraphs [0035], [0043], and [0044]) and a first electrode (140) having a contact area therebetween that extends into a recess (generally indicated by the space occupied by 130; "recess" is interpreted broadly, and see Gill et al. U.S. Patent 6,791,107, Fig. 3, column 4, lines 10-30, for a similar structure with a similar recess) of

the first electrode to provide current density concentration adjacent thereto, wherein the phase change material layer directly contacts the first electrode throughout the recess.

Note that although the reference does not explicitly disclose the limitation of “to provide current density concentration adjacent thereto”, the structure warrants the limitation.

4. **Claims 1-3** are rejected under 35 U.S.C. 102(e) as being anticipated by Wicker U.S. Patent Application Publication 20040113181 (the ‘181 reference).

The ‘181 reference discloses in the figures, particularly Fig. 12, and respective portions of the specification a phase-change memory device as claimed.

Referring to **claim 1**, the ‘181 reference discloses a phase-change memory device comprising:

a phase-change material layer (120, Fig. 12, paragraphs [0025] and [0059]) and a first electrode (130/140) having a contact area therebetween that extends into a recess (generally indicated by the space occupied by 130; “recess” is interpreted broadly, and see Shipley et al. U.S. Patent 6,944,945, Fig. 3, column 7, lines 48-53, for a similar structure with a similar recess) of the first electrode to provide current density concentration adjacent thereto, wherein the phase change material layer directly contacts the first electrode throughout the recess.

Note that although the reference does not explicitly disclose the limitation of “to provide current density concentration adjacent thereto”, the structure warrants the limitation.

Referring to **claim 2**, the reference further discloses that a portion of the phase-change material layer extending into the recess of the first electrode comprises a tapering tip (“tip” is

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interpreted broadly) of a vertical part of the phase-change material layer that contacts the first electrode at the contact area.

Referring to **claim 3**, the reference further discloses that the phase-change material layer further includes a horizontal part extending above the vertical part and wherein the phase-change memory device further comprises a second electrode (690, Fig. 14) on the horizontal part (“on” is interpreted broadly).

### ***Claim Rejections § 102 & § 103***

The following is a quotation of 35 U.S.C. §103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**5. Claim 4** is rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Wicker U.S. Patent Application Publication 20040113181 (the ‘181 reference).

The ‘181 reference discloses a phase-change memory device as claimed and as detailed above for claim 3 including the tapering tip of the vertical part, and further discloses that the tapering tip of the vertical part is a special V-shaped part, as seen in Fig. 12. Comparing the claim and the reference, the tapering tip of the vertical part of the claim is V-shaped, whereas, the tapering tip of the vertical part of the reference is almost-V-shaped. In other words, the tapering tip of the vertical part of the reference does not have an exact V-shape as claimed. Nevertheless, considering the nature of forming memory devices, particularly phase-change

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memory devices, at the time the invention was made, the dimensions of the recesses for housing the tapering tip of the vertical part appear to be in the sub-lithographical, i.e., in the hundreds of nanometers, and should not be in the microns and definitely not in the millimeters. In other words, the recess for housing the tapering tip of the vertical part and therefore the tapering tip of the vertical part itself should not be visible by the naked eye. In other words, the recess for housing the tapering tip of the vertical part and therefore the tapering tip of the vertical part itself should be in the microscopic scale, and at such a scale, the V-shape and the nearly-V-shape appears to be the same, functionally or to the naked eye.

***Allowable Subject Matter***

6. Claims 5-20 are allowable over the prior art of record.

The following is an examiner's statement of reasons for the indication of allowable subject matter: The cited art, whether taken singularly or in combination, especially when all limitations are considered within the claimed specific combination, fails to teach or render obvious a phase-change memory device having all exclusive limitations as recited in claim 5, 12, and 13, characterized in that: (1) the first electrode comprises a recessed slope part contacting the tip of the vertical part of the phase-change material layer, and a horizontal part extending from the recessed slope part and separated from the horizontal part of the phase-change material layer by an insulation layer; or that (2) a first insulation layer is formed on the interlayer dielectric layer and has a sloped opening, and the first electrode comprises a vertical part formed in the sloped opening and a horizontal part formed on the first insulation layer.

***Conclusion***

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office Action. See MPEP § 706.07(a).

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tu-Tu Ho whose telephone number is (571) 272-1778. The examiner can normally be reached on 6:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, DAVID NELMS can be reached on (571) 272-1787. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Tu-Tu Ho  
November 21, 2005